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HAWAIIAN AGRICULTURAL EXPERIMENT STATION, HONOLULU,

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TWO PLANT DISEASES IN HAWAII.

by

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INTRODUCTION.

Two plant diseases present in these Island, one infesting sugar-cane, the other coffee, are widely distributed wherever these plants are grown and deserve attention in the cultivation of these crops. Their presence need cause no alarm to the producers of either sugar or coffee since both diseases have been well worked out and respond to active measures of control as outlined below.

The Pineapple Disease of Sugar Cane.

An outbreak of a disease of sugar cane on one of the windward plantations of Hawaii was reported to this station in November, 1903. The Entomologist, Mr. D. L. Van Dine, visited the locality and made an examination. Specimens of the diseased cane were referred to Dr. Albert F. Woods, Plant Pathologist and Physiologist of the U. S. Department of Agriculture at Washington, D. C., who reported the cane to be infested with a fungus, *Thielaviopsis ethaceticus* Went, which has caused more or less serious losses in the cane fields of Java, the West Indies and other cane-sugar producing countries.

Fungus is the name applied by botanists to certain lower orders of plants (often microscopic and invisible to the naked eye), which derive their food either from dead or decaying organic matter or by parasitism upon other plants or animals. Fungi do not contain chlorophyl, the green coloring matter in the leaves of flowering plants and ferns. Common examples of fungi are toadstools, moulds, potato blight, etc.

This cane-disease has been reported from nearly every cane growing country in the world. The literature of plant diseases contains abundant references to it. It exists in a number of forms which have been described under different names, according to whether its appearance has been noted on different parts of the cane plant. In its most serious form this fungus

attacks the young seed cane or so injures the eye itself that the cane fails to germinate.

It has been noted in other countries that serious outbreaks almost invariably follow the work of some insect pest, either the cane borer or some external feeder like the leaf-hopper.

The fungus is truly parasitic. The fine (microscopic) white threads which constitute the vegetative stage of the fungus, as soon as they have gained entrance into the tissues of the cane through any artificial wound or puncture of the epidermis such as that made by a leaf-hopper or a cane borer, branch and increase in number until the whole interior of the cane stalk is filled with the mass.

The affected parts, especially the leaves, leaf-sheaths and younger and more tender portions of the cane itself show bright reddish discoloration externally, and if the stalk is cut across or split lengthways, reddish streaks all through the interior tissues. When young plant cane is infected the leaves become a light yellowish green and the plant soon dies. If infected seed is planted the eyes often fail to grow so that the field must be entirely replanted. Cane seed the vitality of which has been affected by this fungus after planting, will be found upon examination to be covered with a mass of fine white threads, the mycelium or vegetative stage of the fungus, while the rind of the cane is covered with little raised blisters. These small pustules, plainly visible to the naked eye are characteristic of this disease.

Older cane when seriously attacked presents a peculiar stunted appearance, a sudden decrease in the thickness and length of the joints, dying of the leaves and, finally, if the fungus gains the upper hand the whole plant is killed into the ground. Such killing of the cane by this fungus was observed during February, 1904, in fields where the vigor of the cane had been seriously impared by the leaf-hopper. The fruiting stage of the fungus appears on the rind of the dead cane-stalks in the same form as on seed cane, as minute pustules or blisters from the middle of which exudes a black sooty mass consisting of millions of very minute oblong spores,—the "seeds" of the fungus, ready to be blown about by the wind or carried to other cane plants on the bodies of insects.

This disease has been known as "Pineapple disease," the name being applied because of the pineapple odor of freshly cut stalks of cane infected with the fungus. This odor is really due to the formation of acetic ether by the fungus from the saccharine substances within the cane stalk.

In some localities in Hawaii, this disease has been termed "Eleau," but in the opinion of the writer that name more properly applies to a fungus disease which causes a gumming up of the leaf sheath, so that when the cane is stripped the fibres of the sheath remain adherent to the cane.

It has been noted in both the West Indies and Java that where there is any considerable amount of this disease present in the fields that are being harvested, there is a marked retardation of crystallization of the juice.

For the protection of cane seed against this fungus it has been recom-

mended in Java that the cut ends of the seed be coated with tar before planting. Howard[1] investigated methods of prevention and found that better results were obtained by dipping the seed in Bordeaux mixture or in a combination of Bordeaux mixture and tar than by the use of tar alone. He also recommends the use of top seed, because the top joints contain less sugar than the lower joints, and are hence less liable to be attacked by the fungus.

This fungus disease can readily be kept in check:

1. By selecting for seed, cane that is perfectly sound and healthy;

2. By carefully gathering up and burning the stalks left on infected fields after the cane has been harvested.

As before stated this fungus usually proves serious only to young plant cane or to older cane, the growth of which has first been checked by attacks of injurious insects, in which case infection of the cane with the fungus occurs through the wounds made by the insects.

Whenever young plant cane looks yellow and sickly, or when seed cane fails to germinate, or when growing cane shows retarded growth and has its leaves and stalks streaked with red patches, or when dead cane either standing in the fields or that which is left on the field after the crop has been harvested appears light and spongy and is covered with small pustules or blisters, the patches of cane exhibiting any or all of these symptoms should be looked on with suspicion. Under no circumstances, should seed cane be taken from such fields.

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[1] Howard in West Ind. Bul. Vol. 3. No. 1, 1902.

The Brown-Eyed Disease of Coffee.

A fungus-disease of coffee, causing spotting of the leaves and injury to the berry, is widely prevalent, although rarely destructive, in the Hawaiian coffee plantations. This fungus has been identified by Mrs. F. W. Patterson, Mycologist of the U. S. Department of Agriculture at Washington, D. C., as *Cercospora coffeicola* B. & C. Its presence in Hawaii was noted as early as 1896 or 1897 by Prof. A. Koebele, the well-known entomologist. In January, 1899, Prof. Koebele reported this fungus as causing some losses in Puna and Olaa. He says: "In the wet or cooler parts of Puna and Olaa the disease seems to spread. As yet it is only serious to weak trees or nursery plants where exposed, but is hardly noticeable on healthy and vigorous trees." Its presence on coffee trees has been noted during the past three years in all the coffee districts which the writer has visited. As Professor Koebele points out in his letter in which he first drew the attention of our Department to the occurrence of this fungus disease in Hawaii, it is most prevalent on weak trees, such as those in neglected and uncared for plantations, or on isolated trees growing in unfavorable localities, such as door-yards, washed ridges, barren hillsides and rocky, shallow soils.

The Brown-eyed disease has been reported from Jamaica, Guatemala, Gaudeloupe and from Brazil, in the latter country being widely distributed through all of the coffee-growing provinces. [1]Noack, who has studied the life history of this fungus in Brazil, describes it as follows: "The disease produced by this fungus is called the Brown-eyed disease on account of the brown spots formed on the leaves. As a rule these are round or oval, on the lower surface clear brown, on the upper surface dark brown. In the center the spots are lighter and grayish. The margin is sharply defined on the upper surface, dark brown or reddish, generally slightly raised, the surface often marked by fine concentric striae. Frequently several spots unite. The nerves of the leaves do not prevent their spreading. The average diameter of the spots at the center of the leaf is one-fifth of an inch. The largest are about one-third of an inch. If a leaf is badly affected it appears more or less brown. The formation of the spots begins on the upper surface of the leaves. The spots are at first without a sharp marginal line and are scarcely visible on the under surface. The fungus not only occurs on the leaves but on the half-formed cherry. On these, little dark spots appear, which multiply and spread until finally about half the cherry becomes brown and dried."

Many of the cherries which are infected with this disease drop off. Those which remain on the tree do not ripen well and the beans become black, besides being incompletely developed. Even in milder attacks where the above serious condition does not prevail and the bean remains uninjured great difficulty is met in properly hulling the infected berries.

The minute spores of the fungus may be blown about by the wind or

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[1]Zeit. f. Pflanz. Krank. XI, 196, 1901.

carried from one plant to another on the bodies of insects. Infection has been shown to occur only when the epidermis of the leaf is punctured by insects such as the aphis and torpedo fly (*Siphanta acuta.*)

Treatment to prevent serious losses from this fungus disease would naturally come under two heads, first. improving the general condition of the the coffee by better tillage of the soil and the use of the proper fertilizers; second, where many trees are seriously affected and it is desirable to prevent the spread of the fungus through the plantation, by the use of fungicidal sprays or washes.

So far as recorded in the literature relating to the Brown-eyed disease of coffee no actual experiments with controlling it by the use of fungicides have been made. Similar diseases of other plants have, however, been successfully controlled by the use of Bordeaux mixture and the ammoniacal solution of copper carbonate. Fungi of the genus *Cercospora* are the cause of diseases of celery, plum, sugar beet and mignonette. In each of these cases. one or the other of the above remedies have proved effectual. By analogy it is perfectly safe to recommend the use of fungicides. The time of application and strength of solution required will, however, have to be worked out by the individual planter to suit local conditions. Both fungicides must be applied by means of a spray pump[1] in the same manner as insecticides.

The following directions for preparing these fungicides are reprinted from Dr. B. T. Galloway's bulletin, "Spraying for Fruit Diseases."[2]

Bordeaux Mixture.—"In a barrel or other suitable vessel place 25 gallons of water. Weigh out 6 pounds of copper sulphate, then tie the same in a piece of coarse gunny sack and suspend it just beneath the surface of the water. By tying the bag to a stick laid across the top of the barrel no further attention will be required. In another vessel slack 4 pounds of lime, using care in order to obtain a smooth paste, free from grit and small lumps. To accomplish this it is best to place the lime in an ordinary water pail and add only a small quantity of water at first, say a quart or a quart and a half. When the lime begins to crack and crumble and the water to disappear add another quart or more, exercising care that the lime at no time gets too dry. Toward the last considerable water will be required, but if added carefully and slowly a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to 25 gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper suphate solution slowly together into a barrel holding 50 gallons. The milk of lime should be thoroughly stirred before pouring. The method described insures good mixing, but to complete

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[1]For description of the various forms of spraying devises see Bul. No. 3 of this Station: "Insecticides for use in Hawaii."

[2]U. S. Dept. Agric., Farmers' Farmers' Bulletin No. 38.

this work the barrel of liquid should receive a final stirring, for at least three minutes, with a broad wooden paddle.

It is now necessary to determine whether the mixture is perfect—that is, if it will be safe to apply it to tender foliage. To accomplish this, two simple tests may be used. First, insert the blade of a penknife in the mixture, allowing it to remain there for at least one minute. If metallic copper forms on the blade, or, in other words, if the polished surface of the steel assumes the color of copper plate, the mixture is unsafe and more lime must be added. If, on the other hand, the blade of the knife remains unchanged, it is safe to conclude that the mixture is as perfect as it can be made. As an additional test, however, some of the mixture may be poured into an old plate or saucer, and while held between the eyes and the light the breath should be gently blown upon the liquid for at least half a minute. If the mixture is properly made, a thin pellicle, looking like oil on water, will begin to form on the surface of the liquid. If no pellicle forms, more milk of lime should be added."

Ammoniacal Solution of Copper Carbonate.—"This preparation, as now generally used, contains—

Water	45 gallons.
Stronger aqua ammonia	3 pints.
Copper carbonate	5 ounces.

The copper carbonate is first made into a thin paste by adding a pint and a half of water. The ammonia water is then slowly added, and if of the proper strength, i. e., 26 degrees, a clear, deep-blue solution is obtained, which does not become cloudy when diluted to 45 gallons.

"The ammoniacal solution of copper carbonate being a clear liquid, its presence on the leaves, fruit ,and other parts of the treated plants is not so noticeable as where the preparations containing lime are used.

"In case it is desired to keep the strong solution as a stock preparation, the bottle or jug in which it is placed should be tightly corked."

The Brown-eyed disease of coffee almost invariably appears first on poorly nourished trees growing in unfavorable situations.

If observations made here in Hawaii confirm those made by Noack in Brazil, that the spores of this fungus are carried from one plant to another by insects, thus bringing about the spread of infection through a plantation from sickly, poorly developed trees to the more vigorous and healthy ones, a proper method of treatment of this fungus disease would be to destroy the torpedo flies and aphis by insecticides. This treatment should be followed by tillage of the soil, the use of fertilizers, the planting of wind-breaks, or any other remedial measure practicable to improve the vigor of the coffee tree, since it is an accepted fact that trees in a vigorous, healthy condition are far more resistant, both to insect pests and fungus diseases, than trees that are poorly developed.

JARED G. SMITH.

Honolulu, H. T., March 16, 1904.